EXP-21a

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ACCELERATOR EXPERIMENT--Remanent Sextupole Field in the Main Ring II.

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This is a continuation of measurements already reported (Exp-21, 8/23/72). The calibration of the momentum, $\Delta p/p$, is believed to be better than that of the previous experiment. Vertical and horizontal tunes are all measured at 7.22 GeV with the following arrangement of air-core sextupoles:

No sextupoles at A & D: 11, 12, 15, 18

C & F: 19, 24, 32, 34, 36, 38, 44, 46, 47, 48

Double sextupoles at C & F: 15, 26

Note that this arrangement does not produce 61st harmonic component of the sextupole field.

(A) Vertical tune measurements

1. Sextupole current 42 Amp.

$\xi_y \equiv 0.637\ B_1'' + B_2'' = -1.256\ kG/m^2$

2. 30 Amp.

$\xi_y = -1.243\ kG/m^2$

3. 22.5 Amp.

$\xi_y = -1.277\ kG/m^2$

Average $\xi_y = -1.259\ kG/m^2$

This should be compared with the previous result $-1.224\ kG/m^2$ (this is a revised value and is slightly larger than $-1.143\ kG/m^2$ given in Exp. 21).

(B) Horizontal tune measurements

Data on horizontal tunes are believed to be less reliable than vertical tune data. Higher order nonlinearity gives more distortion to the tune vs momentum line.

1. 42 Amp.

There is a striking difference between the behavior for $\Delta p/p>0$ and the behavior for $\Delta p/p<0$.

$\xi_x \equiv 2.151\ B_1'' + B_2'' = -2.539\ kG/m^2$ for $\Delta p/p>0$

$= -2.120\ kG/m^2$ for $\Delta p/p<0$.

2. 30 Amp.

$\xi_x = -3.003\ kG/m^2$

3. 22.5 Amp.

$\xi_x = -2.665\ kG/m^2$

If we take a simple average of these four values,

Average $\xi_x = -2.582\ kG/m^2$

From ξ_x and ξ_y, we get

$B_1'' = -0.874\ kG/m^2$

$B_2'' = -0.703\ kG/m^2$ Ratio = 1.24

Measurements of the remanent fields by C. Schmidt,

$B_1'' = -0.636\ kG/m^2$, $B_2'' = -0.568\ kG/m^2$ (revised),

make this ratio 1.11.

The dependence of tunes on the momentum is then

$\Delta\nu_x = -200\ (\Delta p/p)$

$\Delta\nu_y = +129\ (\Delta p/p)$ including the chromatic abberation of quadrupoles.

In order to have both tunes compensated simultaneously with the same current in all sextupoles, we should make

$$\frac{\text{total } (\beta_x X_p) \text{ at sextupole positions}}{\text{total } (\beta_y X_p) \text{ at sextupole positions}} = 1.55.$$

Such an arrangement is now being set up in the main ring and tunes will be measured soon.

Effects of the 61st harmonic component of sextupole field on beam stability have not been demonstrated conclusively. However, it is desirable not to introduce this component in rearranging air-core sextupoles. The amount of 61st harmonic component in the ring due to the variation of B_1'' and B_2'' from dipole to dipole are not known very well. In order to make a quantitative measurement of this effect, it is essential to reduce the ripple in the quadrupole current.

All data used in this report are in the log book, Main Ring Experiments 2, pp. 113-114 and pp. 125-131. A brief discussion of the effect of 61st harmonic component is given in a memo to S. Mori and R. Stiening (August 21, 1972).

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